

## REMARKS

The Office Action mailed 22 June 2010 has been received and its contents carefully noted. Claims 1-6, 9, 12-13 and 25-28 were pending and claims 14-17, 19-20 and 23-24 were withdrawn from consideration. Support may be found in the specification and the claims as originally filed. No statutory new matter has been added. Therefore, reconsideration and entry of the claims as amended are respectfully requested.

### The Claimed Invention

The claimed invention comprises a homogenous mixed layer of a first catalyst metal and a second catalyst metal which are deposited as a combined loading on both an aluminum oxide and an oxygen storage component. In particular, as set forth in the specification, both the catalyst metals, e.g. palladium and rhodium, are added to a slurry of aluminum oxide and an oxygen storage component. Surprisingly, Applicant discovered that the use of a meso-porous (i.e. 150–1000 Å) aluminum oxide and a meso-porous (i.e. 150–1000 Å) oxygen storage component allows one to deposit, as a combined loading, two different catalyst metals (which normally form an alloy under alloying conditions) on a support which do not alloy under alloying conditions. As such, it is not necessary to employ selective placement, deposit one catalyst metal on one support and the other catalyst metal on a different support, and/or selective concentration in order to prevent alloy formation.

The combined loading, in the absence of selective placement, of two platinum group metals on both meso-porous aluminum oxide particles and a meso-porous oxygen storage component not only prevents alloy formation between the two metals, but also results in a catalyst layer having a homogenous mixture of the aluminum oxide particles and the oxygen storage component each having an equal distribution of both metals deposited thereon, thereby providing a catalyst layer having a uniform morphology and distribution of the platinum group metals throughout.

This uniform morphology and distribution of the layers according to the claimed invention is evidenced by Figures A and B which showed the EDX analysis of palladium and rhodium concentration is a function of location in a washcoat layer according to the present

invention.

Figure A:

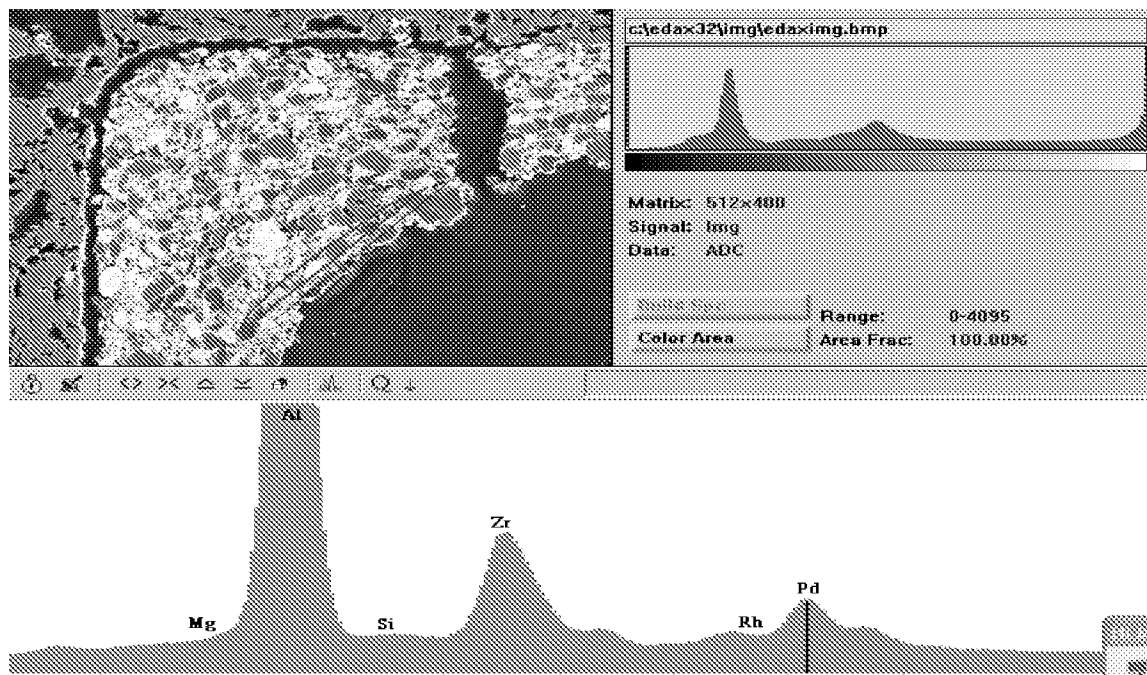


Figure B:

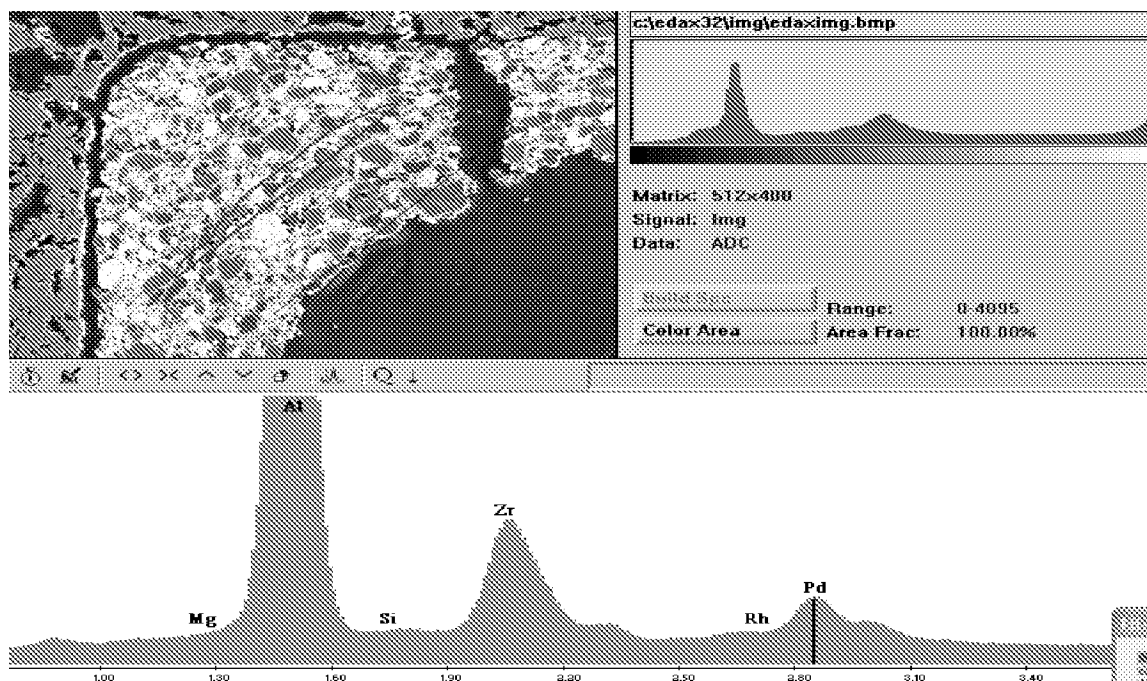


Figure C, as follows, shows that the weight ratio of Pd/Rh is a function of location from the top of the washcoat surface to the bottom surface adjacent to the substrate (WC @ Cordierite) is constant:

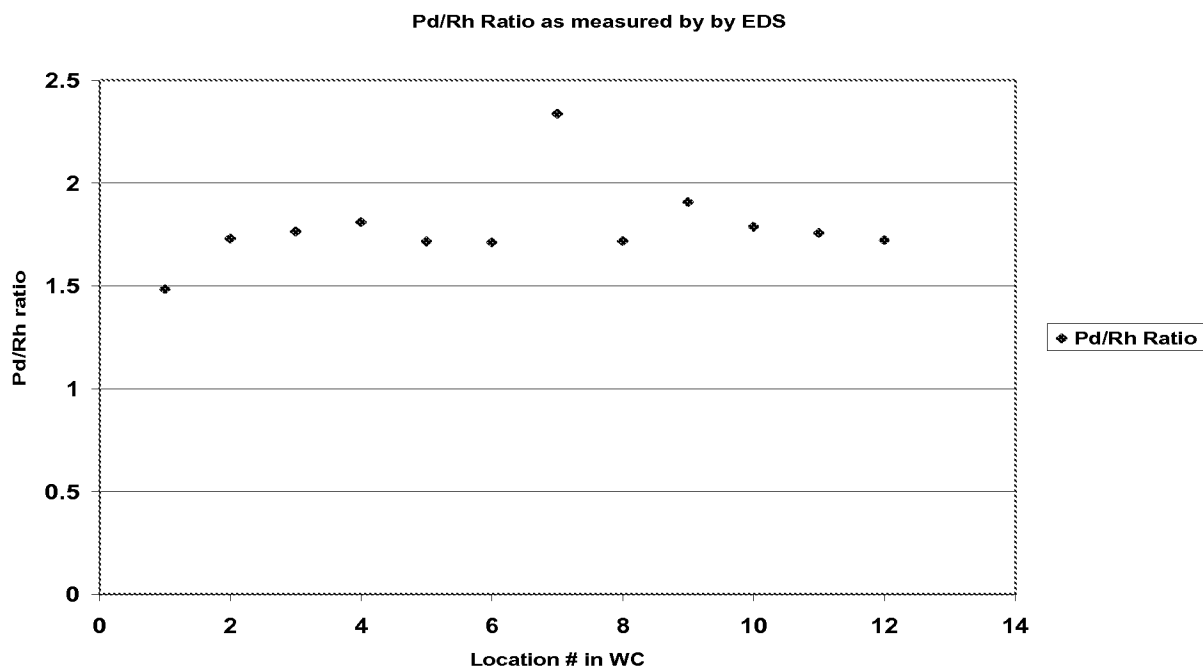
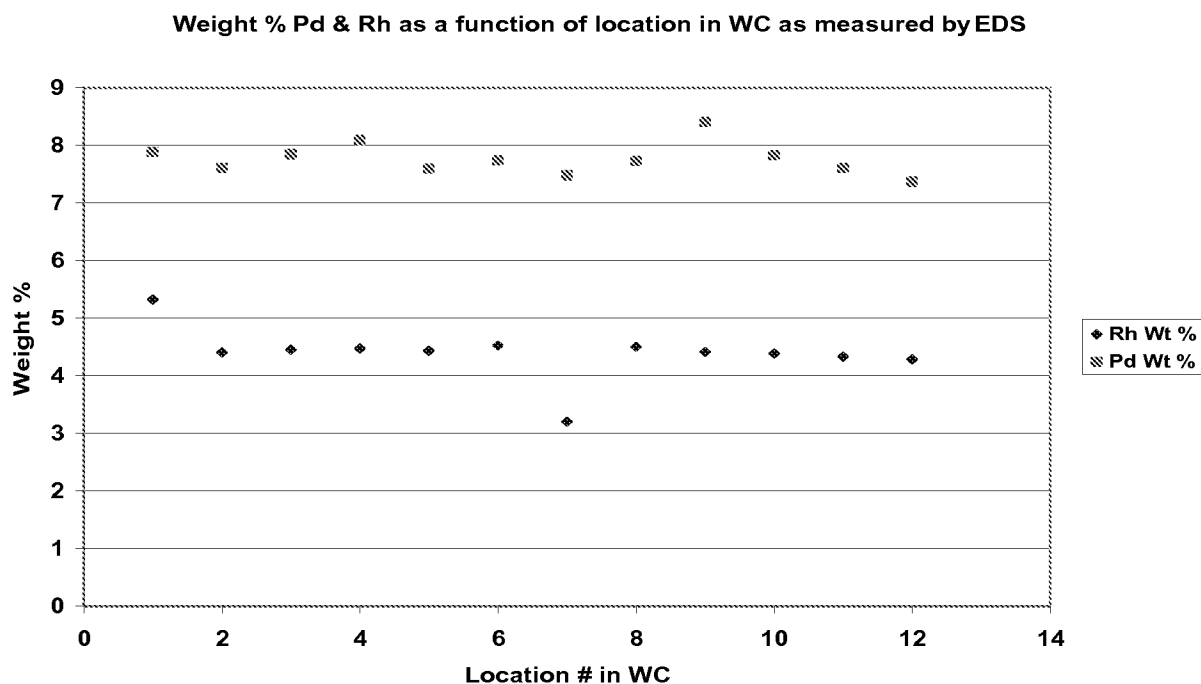


Figure D, as follows, shows that the weight percent of palladium and rhodium as a function of location from the washcoat surface to the bottom surface adjacent to the substrate (WC @ Cordierite) is also constant:



Unexpectedly, Applicant discovered that when both the aluminum oxide and the oxygen storage component are meso-porous, catalyst performance is further improved. For example, Figures 9 and 10 in the instant specification which shows that the 1-layer B design (both aluminum oxide and OSC are meso-porous) provides a significantly better tailpipe emissions and T 50% conversions than 1-layer A design (only the aluminum oxide is meso-porous).

Applicant also unexpectedly discovered that the 1- catalyst layer according to the claimed invention provides better performance at lower PGM loading. Figure E, as set forth below, shows the % conversion for (1) a reference micro-pore (both alumina and OSC are microporous), (2) meso-porous alumina + microporous OSC, (3) meso-porous alumina + meso-porous OSC, and (4) a reference micro-pore (both alumina and OSC are microporous) having higher PGM loading, i.e. Pt+Rh = 40 g/ft<sup>3</sup> @5:0:1. Samples (1) to (3) are single washcoat layers aged by 4-Mode-aging w Max. bed, T = 1050 °C for 50 hrs having Pt+Rh = 25 g/ft<sup>3</sup> @3:0:1.

Figure E:

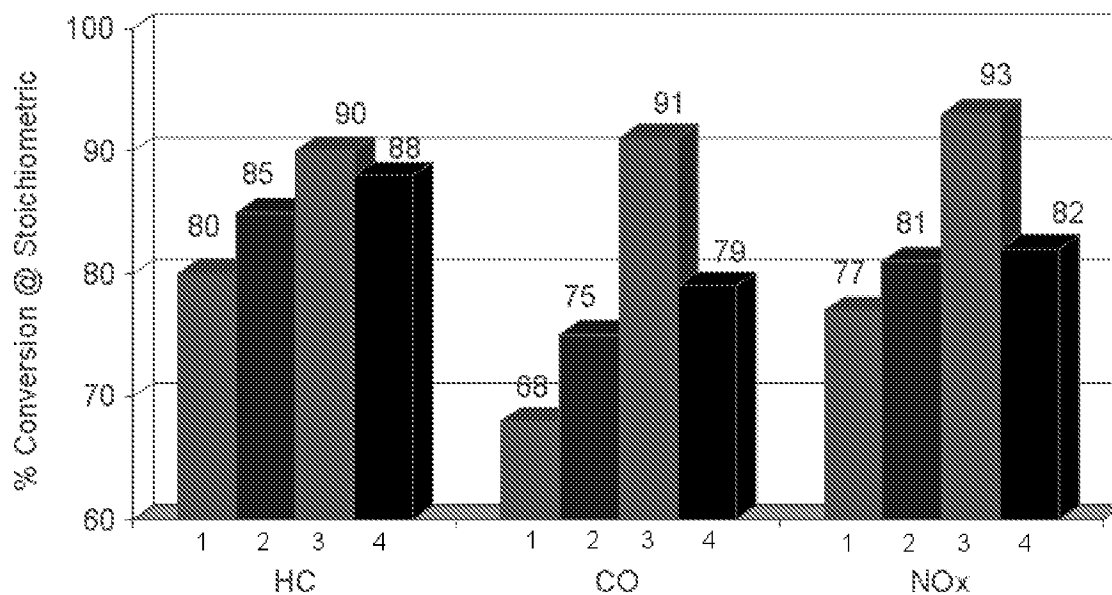


Figure F, as follows, shows that the activity is significantly improved when both the aluminum oxide and OSC are meso-porous:

A/F sweep Test					S A	Pore Volume Cumulative 300 - 1000 Å <sup>o</sup>	Total Pore Volume Cumulative
COP	HC	CO	NOx	m <sup>2</sup> /g	cm <sup>3</sup> / g	cm <sup>3</sup> / g	
1	72.0	80	68	76	45.0	0.063	0.227
2	77.7	84	74	81	57.3	0.165	0.317
3	91.9	87	87	90	45.8	0.195	0.311

Figure F evidences that the significant improvement in activity does not correlate with total pore volume or surface area, but instead correlates with the pore volume in the pore diameter range of 300–1000 Å.

**Rejections under 35 U.S.C. 103(a)**

The Examiner rejected claims 1–6, 9 and 28 under 35 U.S.C. 103(a) as being unpatentable over Ohata (EP 0337809A2) in view of Fujitani (US 4,239,656). The Examiner rejected claims 12 and 26 as being unpatentable over Ohata in view of Fujitani and further in view of Anatoly (US 6,387,338). The Examiner rejected claim 13 as being unpatentable over Ohata and Fujitani and further in view of Suzuki (US 6,335,305). The Examiner rejected claim 25 as being unpatentable over Ohata in view of Fujitani and Foster (US 5,857,140) and Anatoly. In formulating these rejections, the Examiner cited Ohata as disclosing a homogenous mixed layer comprising a first catalyst metal, a second catalyst metal, an aluminum oxide and an oxygen storage component. The Examiner noted that Ohata fails to explicitly disclose the aluminum oxide and the oxygen storage component having average pore diameters of about 150 Å to about 1000 Å. Thus, the Examiner cites Fujitani for disclosing the average pore diameters as set forth in the instant claims.

Applicant respectfully submits that the disclosure of Ohata cannot be combined with that of Fujitani, alone or in combination with Anatoly, Suzuki and/or Foster, in order to obtain the present invention as claimed. Specifically, it is improper to modify the two inventive embodiments of Ohata in order to provide a homogenous mixed layer of a first catalyst metal and a second catalyst metal which are deposited as a combined loading on both a meso-porous aluminum oxide and a meso-porous oxygen storage component such that the first catalyst metal and the second catalyst metal do not form an alloy under alloying conditions.

The invention of Ohata is directed to preventing rhodium from undergoing negative interactions, with the support material such as alumina and/or ceria, which result in reduced activity. See page 2, lines 21–29 and 35–39. Ohata prevents such negative interactions by the following two inventive embodiments: (a) concentrating an amount of rhodium ranging from 0.02–2 % by weight of the catalyst composition on a small part of the support material to give a high concentration of 1–20% by weight based on the refractory inorganic oxide particles, and (b) stabilizing the ceria with a high surface area zirconia ( $\text{ZrO}_2$ ) together with yttria and/or calcia. See page 2, lines 59–65, page 3, lines 1–12, and Example 6.

With respect to embodiment (a), Ohata teaches that the loading of rhodium on the

washcoat as a whole can be in the range of 0.02–2% by weight, but if the concentration of rhodium is less than 1% on the refractory oxide support, the rhodium is considered highly dispersed and will undergo a negative interaction. See page 3, lines 32–43. According to the examples of Ohata, embodiment (a) is achieved by separately impregnating rhodium on alumina by using a solution containing 0.3–0.5 g of rhodium to 5–10 g of alumina (e.g. Examples 3–5) to give a high concentration of rhodium on alumina and then adding the cerium compound. Control experiments (e.g. Controls 4 and 5) employed a solution containing 0.5 g of rhodium to impregnate 100–220 g of alumina, thereby resulting in highly dispersed, i.e. low concentrations of, rhodium on alumina. Therefore, these catalysts do not contain a homogenous mixed layer of a first catalyst metal and a second catalyst metal which are each deposited as a combined loading on both an aluminum oxide and an oxygen storage component in accordance with the instant invention.

Applicant respectfully submits that it is improper to modify inventive embodiment (a) of Ohata such that palladium and rhodium are each deposited as a combined loading on both the aluminum oxide and the oxygen storage component since Ohata teaches the necessity of depositing a higher concentration of rhodium on the aluminum oxide. In other words, depositing palladium and rhodium each as a combined loading on both aluminum oxide and the cerium compound would not result in the higher concentration of rhodium on the aluminum oxide. Therefore, Ohata teaches against the present invention as claimed.

Although the catalysts of Example 10 to Control 13 of Ohata contain both palladium and rhodium as a combined loading, these specific examples are directed to embodiment (b) wherein the oxygen storage component is Ce-ZrO<sub>2</sub>, which is not the same as the oxygen storage component as set forth in the instant claims – ceria having a stable cubic structure represented by the formula (Ce<sub>a</sub>Zr<sub>b</sub>La<sub>c</sub>Y<sub>d</sub>Pr<sub>e</sub>O<sub>x</sub>), wherein subscripts a, b, c, d, e, and x, represent atomic fractions, and wherein a + b + c + d + e = 1. Specifically, Ohata teaches the oxygen storage component, i.e. cerium oxide stabilized with zirconia (ceria incorporated in the form of a solid solution in zirconia), is a tetragonal crystal. See page 4, lines 1–4, lines 12–15, and lines 23–29, Table 2/page 7, and Figures 1–4. In fact, Ohata teaches that (a) commercially available ceria, (b)

zirconia powder impregnated with cerium nitrate and a Ce-ZrO<sub>2</sub> powder, ceria, activated alumina, iron oxide, (c) zirconia and cerium nitrate, and (d) monoclinic cerium oxide do not provide sufficient catalyst performance. Thus, Ohata teaches the necessity of, at least, a tetragonal cerium oxide stabilized zirconia. Nowhere does Ohata teach or suggest that other cerium containing compositions are equivalent to or may be used instead of tetragonal cerium oxide. Nowhere does Ohata teach or suggest that the oxygen storage component may be a stable cubic structure having the formula Ce<sub>a</sub>Zr<sub>b</sub>La<sub>c</sub>Y<sub>d</sub>Pr<sub>e</sub>O<sub>x</sub> as set forth in the instant claims. In addition, nowhere does Ohata teach or suggest that the oxygen storage component, i.e. cerium oxide, should be meso-porous (i.e. 150–1000 Å). Since Ohata teaches the necessity of tetragonal cerium oxide stabilized zirconia in embodiments where rhodium is not more concentrated on refractory oxide particles, i.e. where rhodium and palladium and/or platinum are deposited by combined loading, it is improper to modify embodiment (b) of Ohata such that the ceria is not tetragonal cerium oxide stabilized zirconia, but is instead a stable cubic structure and the formula (Ce<sub>a</sub>Zr<sub>b</sub>La<sub>c</sub>Y<sub>d</sub>Pr<sub>e</sub>O<sub>x</sub>).

Further, nowhere does Ohata teach or suggest that the refractory inorganic oxide particles, e.g. aluminum oxide, must also be meso-porous (i.e. 150–1000 Å). In fact, it should be noted that prior to 1995, meso-porous alumina had not been obtainable. See Baca et al. (2008) Microporous in Mesoporous Materials 110:232-241 (enclosed). Therefore, nowhere does Ohata teach or suggest that both the refractory oxide particle, i.e. the aluminum oxide, and the oxygen storage component, i.e. cerium, must be meso-porous when two catalyst metals<sup>1</sup>, such as rhodium and palladium, are deposited by combined loading in order to prevent the catalyst metals from forming an alloy which results in reduced catalytic performance.

Applicant respectfully submits that Fujitani, alone or in combination with Anatoly, Suzuki and Foster, do not alleviate the deficiencies of Ohata. Nowhere does Fujitani teach or suggest that combined loading of two platinum group metals on meso-porous refractory inorganic oxide particles, such as aluminum oxides, and a meso-porous oxygen storage component, such as cubic cerium oxide, will prevent alloy formation between the two metals.

The Examiner cites Anatoly and Suzuki for their disclosures relating to cubic cerium

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<sup>1</sup> The other catalysts (e.g. Example 8 to Control 11) exemplified in Ohata only contain rhodium, i.e. the catalysts do



oxide. However, as provided above, Ohata teaches the necessity of tetragonal cerium oxide stabilized zirconia when rhodium is not more concentrated on the refractory inorganic oxide particles. Nowhere do the cited documents, alone or in combination, teach or suggest employing cubic cerium oxide instead of tetragonal cerium oxide stabilized zirconia when rhodium is not more concentrated on the refractory inorganic oxide. Therefore, the Examiner has failed to set forth the requisite reasoning as to why one of ordinary skill in the art would have been motivated to obtain a combined loading of two platinum group metals on both meso-porous aluminum oxide and meso-porous cubic cerium oxide.

Last, the Examiner cites Foster for disclosing a retention material in the housing around the retention material and the substrate. Nowhere does Foster teach or suggest the combined loading of two platinum group metals on meso-porous refractory inorganic oxide particles, such as aluminum oxides, and a meso-porous oxygen storage component, such as cubic cerium oxide, in order to prevent alloy formation between the two platinum group metals.

Thus, Applicant respectfully submits that the cited documents, alone or in combination, do not teach or suggest the claimed invention. Therefore, the rejections under 35 U.S.C. 103(a) should be properly withdrawn.

### **Request for Rejoinder**

Applicant respectfully requests rejoinder of withdrawn claims 14-17, 19-20 and 23-24. Should the Examiner deem that rejoinder is inappropriate, Applicant respectfully request that the Examiner telephone the undersigned in order to authorize an Examiner's Amendment.

### **Request for Interview**

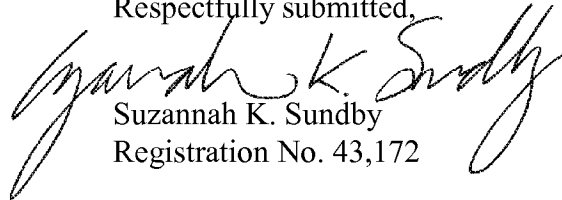
Either a telephonic or an in-person interview is respectfully requested should there be any remaining issues.

### CONCLUSION

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Therefore, it is respectfully requested that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Official action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

It is not believed that extensions of time are required, beyond those that may otherwise be provided for in accompanying documents. However, in the event that additional extensions of time are necessary to prevent abandonment of this application, then such extensions of time are hereby petitioned under 37 C.F.R. 1.136(a), and any fees required therefor are hereby authorized to be charged to **Deposit Account No. 024300**, Attorney Docket No. **034166.053**.

Respectfully submitted,



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